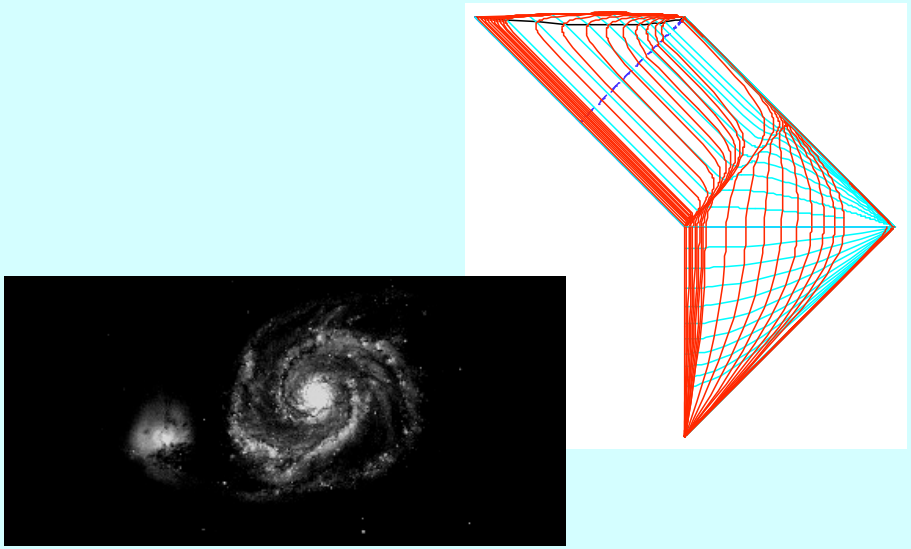
A Tribute to Beth A. Brown



James Lindesay
Professor of Physics
Director, Computational Physics Lab
Howard University

Astrophysicist, Humanist, Scholar

4 February 1969 Roanoke, Va. - 5 October 2008 Greenbelt,, Md

Family

Pipeline begins at birth

Largest impact upon future accomplishments remains family and close friends

Beth and Mom

Beth and Larry

Extended Family

Godfather

Family, Friends and Cohorts

Keivan Stassun, Astronomy, Vanderbilt University

Chanda Prescod-Weinstein, Astrophysics, Perimeter

Aziza Baccouche, Physicist, Video Productions

Howard University and Family

Primary and Secondary Ed

- Parents got her a telescope at an early age
- Grew up watching Star Trek and Star Wars, decided to be an astronaut
- Also played the flute

William Fleming High School Class Valedictorian

Post-Secondary Education

BS Honors Astrophysics, 1991, Howard University, Summa Cum Laude

PhD Astrophysics, 1998, University of Michigan (1st Af-Am female)

Theoretical and Observational Evidence for Black Holes

A Senior Thesis
Submitted to the Faculty
of the College of Liberal Arts
of
HOWARD UNIVERSITY

in partial fulfillment of
the requirements for graduation from the
Honors Program

Department of Astronomy and Physics

by

Beth A. Brown

*

Washington, D.C.
1991

Table of Contents

Being A Mentor

Howard U Computational Physics Lab

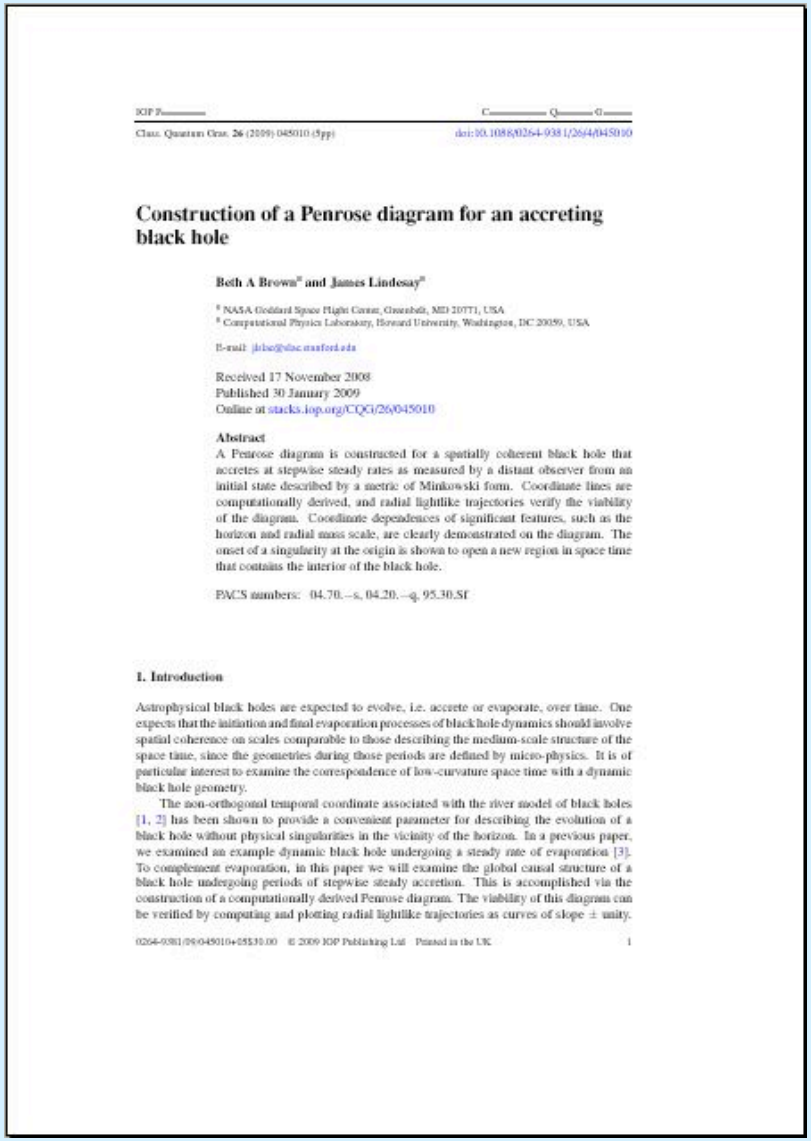
- Mentored students in astronomy and astrophysics at several area Universities
- Developed the popular introductory astronomy course presently being taught at Howard University

Public Outreach

Professional Excellence

Promoted to Assistant Director for Science Communications and Higher Education 2008

Referee's report: This short paper is about constructing just one figure, the Penrose diagram for an accreting black hole. The figure is clear, elegant and clever. It has considerable didactic and pedagogical merits, and for these reasons will surely be used by many authors in presentations and lectures. The paper may be published as it stands.



IOP Publishing — Classical and Quantum Gravity

Class. Quantum Grav. **26** (2009) 045010 (5pp) doi:10.1088/0264-9381/26/4/045010

Construction of a Penrose diagram for an accreting black hole

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Received 17 November 2008
Published 30 January 2009
Online at stacks.iop.org/CQG/26/045010

Abstract

A Penrose diagram is constructed for a spatially coherent black hole that accretes at stepwise steady rates as measured by a distant observer from an initial state described by a metric of Minkowski form. Coordinate lines are computationally derived, and radial lightlike trajectories verify the viability of the diagram. Coordinate dependences of significant features, such as the horizon and radial mass scale, are clearly demonstrated on the diagram. The onset of a singularity at the origin is shown to open a new region in space time that contains the interior of the black hole.

PACS numbers: 04.70.−s, 04.20.−q, 95.30.Sf

1. Introduction

Astrophysical black holes are expected to evolve, i.e. accrete or evaporate, over time. One expects that the initiation and final evaporation processes of black hole dynamics should involve spatial coherence on scales comparable to those describing the medium-scale structure of the space time, since the geometries during those periods are defined by micro-physics. It is of particular interest to examine the correspondence of low-curvature space time with a dynamic black hole geometry.

The non-orthogonal temporal coordinate associated with the river model of black holes [1, 2] has been shown to provide a convenient parameter for describing the evolution of a black hole without physical singularities in the vicinity of the horizon. In a previous paper, we examined an example dynamic black hole undergoing a steady rate of evaporation [3]. To complement evaporation, in this paper we will examine the global causal structure of a black hole undergoing periods of stepwise steady accretion. This is accomplished via the construction of a computationally derived Penrose diagram. The viability of this diagram can be verified by computing and plotting radial lightlike trajectories as curves of slope ± unity.

0264-9381/09/045010+05$30.00 Printed in the UK

Beth's NAFP Abstract

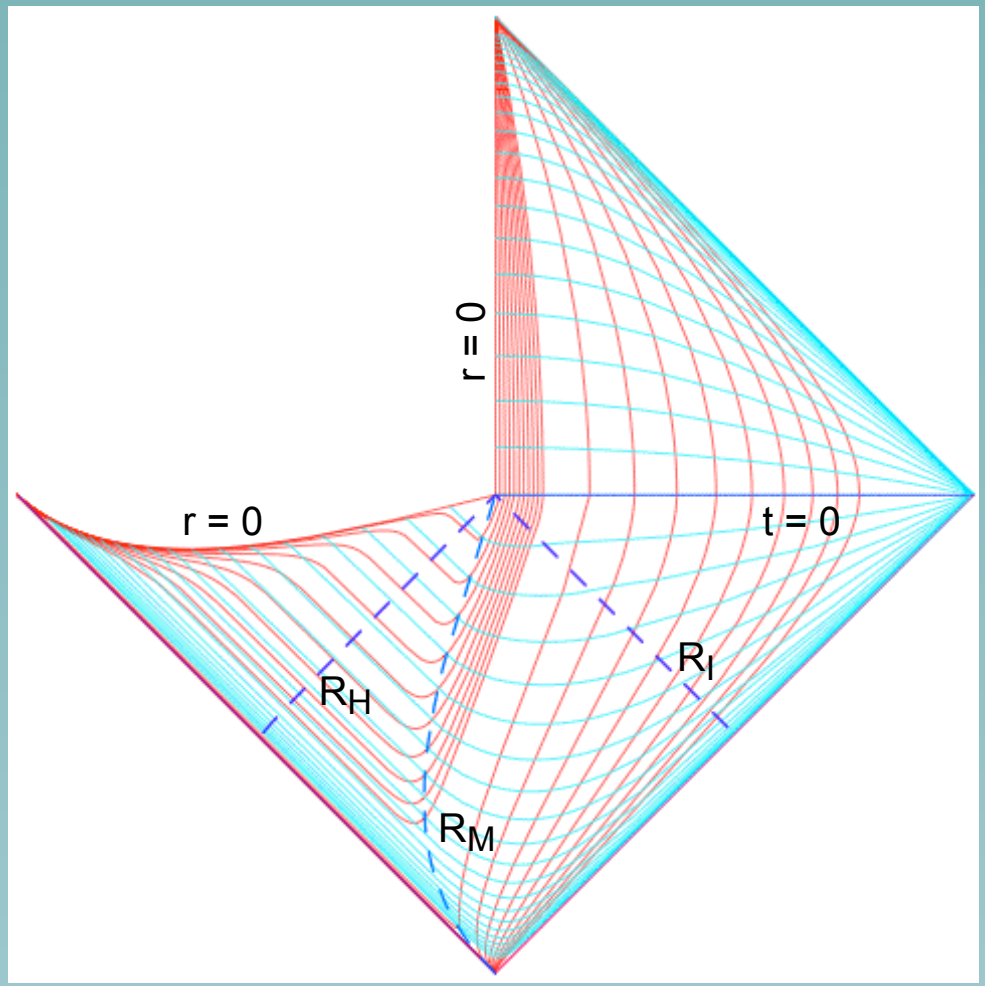
Abstract

Should I be offered a NASA Administrator's Fellowship, I propose to focus my efforts along three lines - curriculum development and teaching, research, and development of recruitment strategies. My primary objective is to work with the Howard University Department of Physics and Astronomy's faculty in creating space science and astrophysics learning modules to be incorporated in an Earth and Space Science curriculum. **I seek to gain invaluable knowledge in effectively communicating astronomy and space science, by teaching within the department. I propose to extend my research experience by initiating a project examining accretion and related processes around black holes. Finally, I propose to work with the department in identifying promising strategies for enhancing the participation of under-represented minorities in the astronomy, space science and physics disciplines.**

The NASA Administrator's Fellowship Program (NAFP) provides a unique opportunity for the professional development of its fellows, while simultaneously benefiting Minority-Serving Institutions and NASA. **I have a great interest in communicating science, and what NASA does, to others.** I also desire to see more minority students pursue a higher education in science, particularly astronomy and astrophysics. The NAFP is a natural fit to my goals, and I am excited about the potential of being a part of this program.

Evaporating Black Hole

Penrose Diagram



Steady rate of evaporation
Mapping from asymptotic coordinates to conformal coordinates.

R_M - radial mass scale; Schwarzschild radius

R_H - event horizon

R_I - incoming causal horizon

Since light-like surfaces are represented in a simple way, causal relationships can be determined in such diagrams in a straightforward manner.